

**A Mussel Survey of
Hillside National Wildlife Refuge**

by:

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**U.S. Fish and Wildlife Service
Ecological Services
6578 Dogwood View Parkway
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Table of Contents

Introduction	1
Mussel Identification	2
Life History and Reproduction	4
Mussel Species List	6
Threeridge	7
Flat Floater	8
Yellow Sandshell	9
Fragile Papershell	10
Pondmussel	11
Washboard	12
Threehorn Wartyback	13
Bankclimber	14
Bleufer	15
Giant Floater	16
Wartyback	17
Pimpleback	18
Mapleleaf	19
Texas Lilliput	20
Pistolgrip	21
Deertoe	22

Pondhorn	23
Paper Pondshell	24
Asian Clam	25
Survey Sites	26
Refuge Map	27
References	28

Introduction

Freshwater mussels are one of the most imperiled groups of animals in North America. Currently 70 mussel species are listed as endangered or threatened under the Endangered Species Act, and a number of others are candidates or potential candidates for protection. Affected by siltation, erosion, polluted runoff, impoundment, channelization, habitat fragmentation, and population isolation, even common and widespread species have declined dramatically from historic levels.

Mussels have been economically tied to the Mississippi River delta and its drainages since prehistoric times. Native Americans not only ate mussels, but also used them for tools, containers, utensils, and jewelry. Early European settlers also consumed them during hard times, and often harvested natural pearls from them. During the late 1800's and early 1900's, mussel shells were harvested to make highly prized pearl buttons, which were shipped throughout the world and became a multi-million dollar industry. During the 1940's the pearl button industry collapsed due to the invention and wide-spread use of plastics. However, about the same time the Japanese cultured pearl industry was coming into its own.

Mussels continue to contribute to the economy today. Few Americans realize that freshwater mussel shells are the primary source of nuclei for the world-wide cultured pearl industry. Shells are still collected and shipped to Japan, China, the Pacific Islands, and Australia where they are cut and rounded into beads for insertion into oysters as nuclei for cultured pearls.

Archaeological and historical accounts suggest the mussels once paved the bottoms of Mississippi Delta Rivers and streams. As filter feeders they removed sediments and detritus from the water. Their partially digested excretion was food for many aquatic invertebrates and fishes.

Mussels are also important indicators of aquatic ecosystem health. Their complex life cycle requires a healthy fish community, stable substrates, and relatively clean water. Changes in water quality, channel stability, or fish density and diversity are usually reflected by a decline in abundance or a loss of species within the mussel community. Monitoring the health and diversity of the mussels within a drainage system is an important tool in aquatic ecosystem management.

Hillside National Wildlife Refuge encompasses and protects a small portion of the unique interface of the Mississippi/Yazoo River alluvial plain with the upland loess hills of central Mississippi. Black Creek originates in the loess hills and forms the primary drainage through the Refuge's diverse swamp complex. Although over 50 species of freshwater mussels have been reported from the Yazoo Basin, there are no previous records or reports of the fauna from the Refuge, Black Creek, or associated drainages. This survey found that Hillside supports the best small stream mussel community surviving in the Yazoo Basin, and among the best of the State of Mississippi.

MUSSEL IDENTIFICATION

The most obvious and persistent feature of the freshwater mussel is its shell. Features used to separate species include the thickness of the shell, presence or absence of teeth inside the shell, presence or absence of pustules and/or ridges, color of the inside or outside of the shell, etc... It is important to realize that features of the shells can also be highly similar between species, as well as variable within a species. Figure 1 shows the basic anatomy of a mussel shell. The anterior end of a mussel shell can be determined by the position of the umbo and pseudocardinal teeth. These are both located anteriorly. In living mussels the more elongate end is usually the posterior end. When replacing a living mussel back into the substrate, it is very important to place the anterior end down, leaving the posterior end exposed to the water.

Important identification characters inside the shell include the nacre color, length and shape of the lateral and pseudocardinal teeth, and depth of the beak cavity. External characters include the color of the periostracum (external skin), and the presence or absence of colored rays; the shape, number, and arrangement of pustules or ridges; the presence or absence of a sulcus or shallow depression running from the beak to the ventral margin of the shell; and the presence or prominence of a posterior ridge.

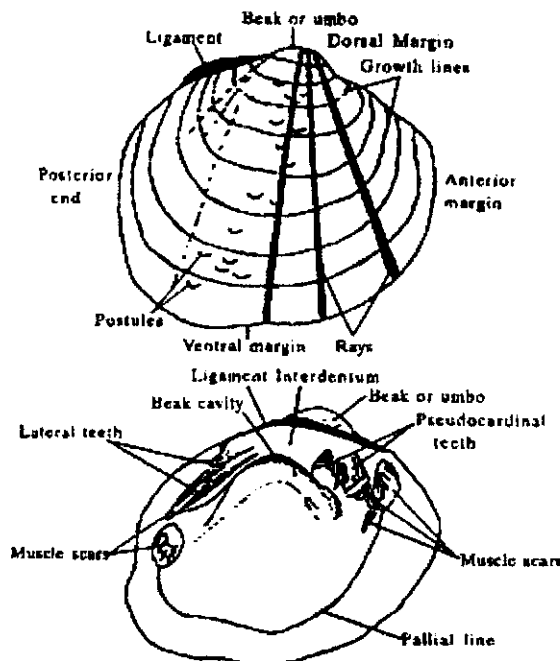


Figure 1: the shell of a Freshwater Mussel

Internal anatomy, or "soft part" characters, are used in classification of mussels into families, genera, and species (Figure 2). The most prominent of these include the number of gills used as marsupia for the larvae, the size and shape of the marsupium, the anatomy of the larvae (glochidia), labial palps, siphons, and mantle characters.

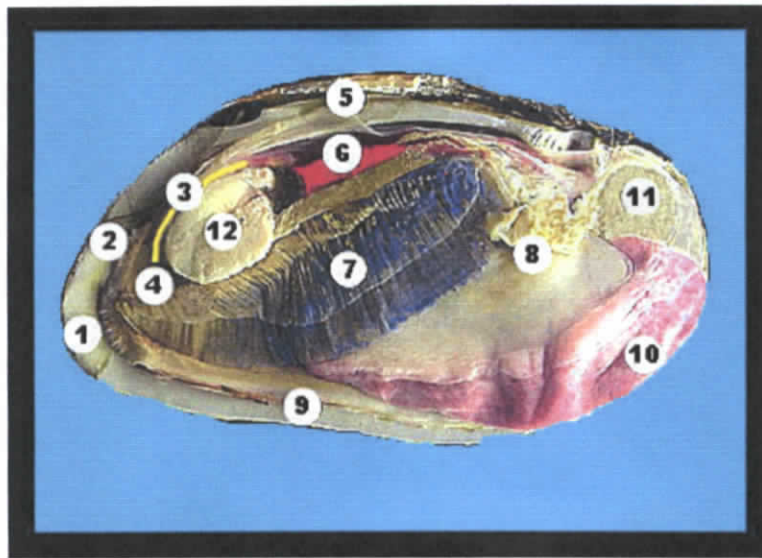


Figure 2: the Body of a Freshwater Mussel

- Key:
- 1: Incurrent siphon
 - 2: Excurrent siphon
 - 3: Intestine
 - 4: Anus
 - 5: Hinge ligament
 - 6: Heart
 - 7: Gills
 - 8: Labial palps
 - 9: Mantle
 - 10: Foot
 - 11: Ant. adductor muscle
 - 12: Post adductor muscle

Freshwater Mussel Life History and Reproduction



Mussel Glochidia

Most fresh water mussels have two separate sexes. A few however, such as the paper pondshell (*Utterbackia imbecillis*), and the lilliput (*Toxolasma parvus*), are hermaphroditic, or have both male and female sex organs. Typically, the males release sperm into the water. The females take in the sperm through the incurrent siphon. Eggs are kept in the water tubes of the female's gills. As water is pumped into the gills, the eggs are fertilized and then develop into larvae, called glochidia. The glochidia lack several of the organs of the adult mussels, and must go through metamorphosis before they can live independently.

In the south eastern United States, virtually all native mussels are parasitic during their larval stage. The glochidia of most of these mussel species use fish as hosts, but some have been known to use other aquatic vertebrates like frogs and eels. For some mussels, only a few species of fish can host the glochidia, but for other mussels, the glochidia can attach to many different kinds of fish. If successful, the larval mussels attach to the gills or fins (depending on the species of mussel) of a host fish where they finish metamorphosis. If the glochidia do not attach to an appropriate host, they cannot survive.

There are many ways in which a female mussel can find a host fish for her young glochidia. A few species of fresh water mussels simply release their larvae as free floating glochidia. These glochidia must wait to float into a fish by chance and can usually use multiple species of fish as hosts. Some species of mussels build a structure of mucus and glochidia, called a conglutinate. The female mussel uses the conglutinate as a "fishing lure" to attract a host fish. When a fish attempts to eat the bait, the conglutinate breaks apart releasing many glochidia in the fish's mouth. The glochidia are then able to attach to the gills. The conglutinates of some species are extremely specialized, and have a close resemblance to a small fish or aquatic invertebrate. Some species of mussel, such as the plain pocketbook (*Lampsilis cardium*), can use their mantle as bait for a passing fish. These mussels wave their specialized mantles, which resemble minnows, crawfish, or other small aquatic animals. When a fish is attracted, the female mussel retracts her mantle and releases her glochidia. The fish receives a mouth full of larvae which attach themselves to the host fish. Other species of mussel build a "net" or "web" of mucus and glochidia. When a host fish swims through the trap, the web breaks apart, freeing the

glochidia which attach to the fish's fins. Mussels such as the exotic *Corbicula fluminea*, or the Asian Clam, do not require a host fish. Instead, their larvae are planktonic.

Once attached to a host fish, a cyst or small abscess forms around the glochidium. There the larval mussels undergo metamorphosis and become juvenile mussels. Some fish can build up a resistance to glochidia, and can only be parasitized once. Glochidia that become attached to resistant fish fall off the fish and die. The parasitic stage of mussel glochidia lasts anywhere from a week to several months. This extreme variation is believed to be affected by mussel species and water temperature. Once metamorphosis is complete, the new juvenile mussel drops off of its host, leaving the fish unharmed. The juvenile mussel will take at least a year to reach sexual maturity, and some species are known to take as long as four years.

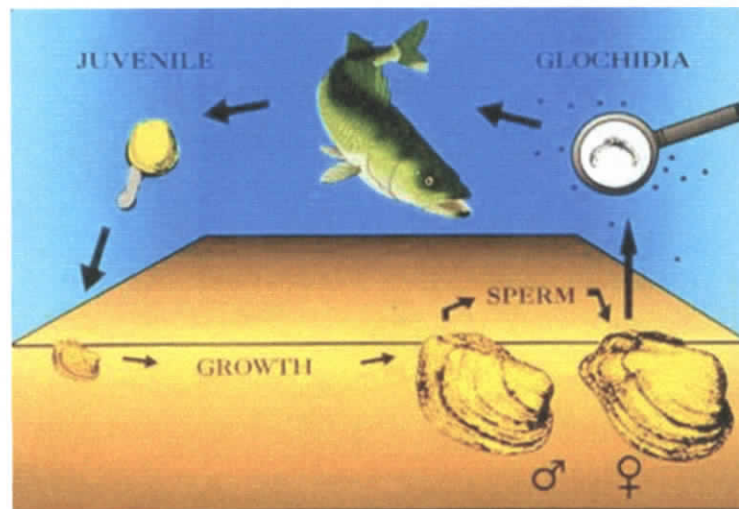


Figure 3: The Freshwater Mussel Life Cycle

Mussel Species List for Hillside NWR

Amblema plicata
Threeridge



This photograph shows threeridges of all ages including an immature mussel that is about one inch in length and a mature mussel that is about three inches in length.

Host Fish include several species of bass, pike, gar, sunfish, pumpkinseeds, warmouth bluegill, perch, crappie, catfish, and sauger.

Characteristics: The threeridge has a thick shell, with large teeth and a low beak. There are large folds or ridges on these shells, extending from the beak to the posterior end of the shell. Its color varies from light brown or green in juveniles, to dark brown, dark green, or black in older adults. The nacre of the shell is bright white, and sometimes iridescent around the edges. The mussel can reach seven inches in length.

The threeridge looks similar to the washboard (*Megalonaias nervosa*), but lacks the pustules on the beak of the shell, which characterize the washboard. The mussel is also sometimes mistaken for the rock pocketbook (*Arcidens confragosus*), but the threeridge has thicker teeth than the rock pocketbook.

Habitat: The threeridge requires some current. Though the mussel is found in rivers and streams of all sizes, it is mostly a large river species. The mussel can live in sand, mud, or gravel.

Status: No live threeridges were found on Hillside NWR during this survey. One dead shell was found at site 15H. The habitat is good here, and a small threeridge population may exist on the refuge.

The threeridge is a commercially valuable species.

Anodonta suborbiculata
Flat Floater



Host Fish include the channel catfish, the warmouth, the green and longear sunfish, the largemouth bass, the golden shiner, and the white crappie.

Characteristics: The flat floater has a thin, smooth, circular shell. The periostracum ranges in color from yellow or yellow-green to dark brown, sometimes with green rays. The beak does not extend above the hinge line, and there are no teeth present. The nacre is white, sometimes light pink, and iridescent. Length can reach about seven inches.

Habitat: The flat floater prefers slow water and can be found in lakes, ponds, and oxbows and slow moving rivers, streams, and creeks. Mud is the preferred substrate of the flat floater.

Status: The mussel was not found on Hillside NWR, but is likely to occur in some of the sloughs, bayous, and perennial ditches located on the refuge.

Lampsilis teres
Yellow Sandshell



Host Fish include the alligator, longnose, and shortnose gar, greenthroat darter, warmouth, bluegill, largemouth bass, yellow perch, white and black crappie, roach, shovelnose sturgeon, and the redbreast, green, and orangespotted sunfish.

Characteristics: The yellow sandshell is smooth, elongated, and moderately thick shelled. Yellow sandshells are often rayed and are yellow, greenish-yellow, or dark yellow-brown. The inside of the shell is white. The mussel has long thin lateral teeth, and fairly well pronounced pseudocardinal teeth. The beak is not extremely high, and extends just above the hinge. The mussel can reach up to six inches in length.

Habitat: The yellow sandshell is a common mussel in most of Louisiana and Mississippi and is found in slow to fast moving water in rivers, streams, creeks, and sometimes lakes and oxbows. Yellow sandshells prefer sand or fine gravel, but are not uncommon in muddy areas.

Status: This mussel can be found on Hillside NWR in Black Creek. The firm sand and mud bottom found under the bridge on Thornton Rd. (site 15H) provide the habitat the mussel prefers. The yellow sandshell was found at site 15H, but the mussel is not abundant on the refuge.

Ligumia subrostrata
Pondmussel



The pond mussel is a *sexually dimorphic* species, meaning males and females of this species have different shells. Males typically have a more pointed posterior end, while the females' posterior end is more rounded. Pictured here is a male pondmussel.

Host Fish include the green sunfish, warmouth, largemouth bass, and bluegill.

Characteristics: The pondmussel has a small, elongated shell. The periostracum can be any where from greenish yellow to brown or black, often with dark green rays. The beak is only slightly elevated above the hinge line, and the teeth are thin. The nacre is an iridescent white. The pondmussel is fairly small, and only reaches about three inches in length.

Habitat: The pondmussel is usually found in smaller bodies of water such as creeks, ponds, bayous, and oxbows. Pondmussels prefer a mud or sand substrate.

Status: The mussel was not found on Hillside NWR but is likely to occur in some of the bayous, swamps, sloughs, and perennial ditches located on the refuge.

Leptodea fragilis
Fragile Papershell



The **Host Fish** is the freshwater drum.

Characteristics: The fragile papershell, has, as its name suggests, a thin, fragile shell, with a smooth and glossy periostracum. The shell is yellow, sometimes with green or brown rays. The beak of this mussel is even with the hinge, which includes small, delicate teeth. The nacre is usually light pink, and iridescent. The mussel can reach up to six inches in length once mature.

The fragile papershell is sometimes confused with the pink papershell (*Potamilus ohiensis*) because the shapes are similar, and both have thin shells. The pink papershell, however, has a high wing on the posterior end of the hinge. When the pink papershell is missing its wings, the two species can be differentiated by nacre color. The pink papershell usually has dark pink nacre, while the fragile papershell has light pink or white nacre.

Habitat: The fragile papershell requires a medium to fast current and typically resides in streams and rivers. Mud, sand, or gravel is a good substrate for the mussel. The fragile papershell may bury deep into the substrate.

Status: The mussel can be found on Hillside NWR in Black Creek. The river bottom is favorable at site 15H and several mussels were found there.

Megaloniaias nervosa
Washboard



This photograph depicts two washboards on the right, and for comparison, a rock pocketbook on the left. Note the thick teeth of the washboard in comparison to those of the rock pocketbook.

Host Fish include the longnose gar, bluegill, longear sunfish, largemouth bass, logperch, yellow perch, and slenderhead darter.

Characteristics: The washboard has a thick, heavy, dark brown shell. The beak does not extend past the hinge. The shell is extremely bumpy and has folds that extend from the beak to the posterior end. This mussel has dark brown or black periostracum, and white nacre with spots of purple or copper. The washboard is one of the larger mussels, and can reach eleven inches in length.

The washboard resembles the threeridge (*Amblyma plicata*), but it can be differentiated by the presence of pustules usually on the beak. The threeridge lacks these pustules, and has a smooth beak. The washboard also looks similar to the rock pocketbook (*Arcidens confragosus*), but the washboard has thicker teeth.

Habitat: The washboard needs some current to survive and is found in large streams, rivers, and bayous. It lives in a mud, sand, or gravel substrate.

Status: On Hillside NWR, this mussel can be found in Black Creek at site 15H. Though the washboard is not abundant in this area, several large, healthy washboards were found there.

The washboard is a commercially valuable species.

Obliquaria reflexa
Threehorn Wartyback



Host Fish include silverjaw minnow, common shiner, and longnose dace.

Characteristics: The threehorn wartyback has a fairly thick, rounded shell. The posterior end is pointed, and there are two or three distinct nodules in a row going down the center of the shell. In younger mussels, there may only be one or two nodules present. The rest of the shell is smooth. Threehorn wartybacks can range in color from yellow to green to light or dark brown. The beaks extend above the hinge line. The nacre is bright white, and the teeth are thick and well developed. The mussel reaches three inches in length.

The threehorn warty back looks similar to the wartyback (*Quadrula nodulata*). The two can be differentiated by the wartyback's more rounded shell and two rows of nodules. Also, the nodules of the threehorn wartyback are usually larger and more pronounced than those of the wartyback.

Habitat: The threehorn wartyback prefers rivers and streams with a considerable amount of flow and a sand or gravel bottom.

Status: On Hillside NWR, dead shells were found at site 15H about 50 yards downstream of the bridge. The threehorn wartyback is probably present in this mussel bed but is not common.

Plectomerus dombeyanus
Bankclimber



This photograph depicts an immature bankclimber (of about one inch in length) and a medium sized adult of about 3 ½ inches.

Host Fish are unknown.

Characteristics: The bankclimber has a thick, elongated shell with an almost square posterior end and rounded anterior end. The periostracum is brown, and becomes darker as the shell ages. The shell has a bumpy surface, with a ridge extending from the beak down to the posterior end of the shell. The beak is not high, and is even with the hinge. The teeth are well developed. The nacre is usually dark to light purple, sometimes streaked. Juvenile mussels often have light pink nacre. Bankclimbers can reach about six inches in length.

The bankclimber looks similar to the pistolgrip (*Tritogonia verrucosa*), but lacks a sulcus, and the large indentation at the end of the sulcus. Also, the posterior end of the bankclimber is square, rather than rounded like the pistolgrip.

Habitat: The bankclimber is typically found in beds near the edges of rivers and streams. The mussel prefers a considerable current and firm mud or sand.

Status: Bankclimbers were not common or abundant on the Hillside NWR, but several small mussels were found at site 15H on Black Creek.

The bankclimber is sometimes used for jewelry making, but is not usually considered a commercial species.

Potamilus purpuratus
Bleufer



Host Fish include the freshwater drum, the warmouth, and the golden shiner.

Characteristics: The bleufer has a fairly thick, inflated shell, with a rounded anterior end. The periostracum can be dark brown, dark green, or black. The beak extends just above the hinge line, and the teeth, though thin, are well developed. The nacre is typically dark pink to dark purple in color. The bleufer is a fairly large mussel, and can reach up to eight inches in length.

Habitat: Bleufers are typically found in large streams and rivers in a firm mud or mud and gravel substrate. The mussel is often difficult to remove from the substrate, as it buries itself deep into the mud and is able to hold on to the substrate with its extremely muscular foot.

Status: Several very large, old bleufers were found in Black Creek at site 15H. Only one young bleufer was found. The deep, fast water and the gravel from the road above provide good habitat for the bleufer on Hillside NWR, but the mussel is not common or abundant on the refuge.

The shell of the bleufer is used in the jewelry industry.

Pyganodon grandis
Giant Floater



Host Fish include the skipjack herring, yellow bullhead, freshwater drum, central stoneroller, Rio Grande cichlid, brook stickleback, gizzard shad, branded killfish, brook silverside, pumpkinseed, bluegill, blacknose dase, roach, creek chub, and several species of bass, suckers, darters, gar, sunfish, shiners, minnows, crappie, perch, and carp.

Characteristics: The giant floater has an elongated, thin shell. Its beak extends above the hinge, and it has no teeth. The nacre color varies from bright white to copper-colored. The periostracum is yellow or brown, sometimes with a hint of green. The mussel's length can reach ten inches.

Habitat: The giant floater prefers slow moving water. The mussel can be found in sloughs, lakes, ox bows, and slow streams or rivers. Bodies of water with a soft mud bottom are preferable.

Status: No live mussels were found on Hillside NWR during this survey. Several fresh dead shells were found on the bank of Black Creek at site 15H, but the current was strong for giant floaters. This species is likely to occur in sloughs, swamps, and perennial ditches on the refuge.

Quadrula nodulata
Wartyback



Host Fish include the channel and flathead catfish, bluegill, largemouth bass, and white and black crappie.

Characteristics: This thick, round shell has two rows of pronounced knobs starting on the beak, and extending down the posterior side of the mussel. The periostracum is usually brown or greenish brown, and the nacre is white and iridescent. The beak extends above the hinge, and the teeth are short, but thick. Wartybacks usually do not grow past three inches in length.

The wartyback and the pimpleback (*Q. pustulosa pustulosa*) can be confused. Usually wartybacks have a double row of two to six large nodules on the shell, while pimplebacks have numerous small pustules. The pimpleback's shell is also typically more rounded. The wartyback also resembles the threehorn wartyback (*O. reflexa*), but the threehorn has only one row of nodules, and the nodules are larger than those of the wartyback. The wartyback is also more rounded than the threehorn wartyback.

Habitat: The wartyback prefers moving water, and is normally found in fast moving rivers and streams. The mussel prefers bodies of water with sand or fine gravel bottom.

Status: Only one wartyback shell was found on Hillside NWR, but the habitat at site 15H was good for the mussel. The mussel is probably present in this stretch of Black Creek but is not common.

Quadrula pustulosa pustulosa
Pimpleback



Host Fish include the black and brown bullheads, channel and flathead catfish, white crappie, and shovelnose sturgeon.

Characteristics: The pimpleback shell is thick, usually covered with small bumps on the posterior end, and brown to yellow in color. Young pimplebacks have a green stripe on their beaks. Their beaks are high, and extend past their hinges. The teeth are heavy, and the nacre is white, often with iridescence. Mature pimplebacks can grow to three inches.

Habitat: Pimplebacks are usually found in rivers, streams, or creeks with a fair to strong current. The mussel prefers a mud, sand, or gravel substrate.

Status: On Hillside NWR, the pimpleback is a common mussel, especially 50 feet downstream of the bridge at site 15H. Here the mussel becomes more abundant. The mussel is present upstream, but is much less abundant.

The pimpleback is a commercially valuable species.

Quadrula quadrula
Mapleleaf



The **Host Fish** is the flathead catfish.

Characteristics: The mapleleaf can be brown, dark brown, and greenish brown. The nacre is pearly white, and iridescent. The beak is elevated slightly above the hinge line, and the teeth are broad. The mapleleaf has two groups of nodules separated by the sulcus. The mussel can grow to about four inches in length.

This smooth sulcus distinguishes the mapleleaf from the Southern mapleleaf (*Quadrula apiculata*), which has pustules extending through the sulcus.

Habitat: The mapleleaf is found in a variety of habitats, with current ranging from fast to slow. Mud, sand, or gravel is the preferred substrate of the mapleleaf.

Status: In Black Creek, on Hillside NWR, the mapleleaf is fairly abundant. The species was prevalent at site 15H especially in the sections with more gravel and less mud.

The mapleleaf is a commercial species in some states

Toxolasma texasiensis
Texas Lilliput



The Texas lilliput is a *sexually dimorphic* species, meaning the male and female mussels have differently shaped shells. Pictured here are a male and female lilliput. The male, on the left, is more elongated, and does not have a broad posterior end like the female, on the right.

Host Fish include the bluegill and the warmouth.

Characteristics: The Texas lilliput has an elongated, slightly inflated shell. The periostracum is usually smooth and dark green, brown, or black. The beak is not high, and extends just above the hinge line. The teeth are thin, and the nacre is white, sometimes with a hint of pink. The Texas lilliput can grow to three inches, but are rarely bigger than 2 ½.

The female Texas lilliput looks similar to the lilliput (*Toxolasma parvus*), but grows much larger. Also, the nacre of the Texas lilliput is not as bright white as that of the lilliput. The female Texas lilliput is also similar to the little spectaclecase (*Villosa lienosa*), but lacks the purple nacre. The female Texas lilliput also has a caruncle attached to its mantle which can distinguish it from the little spectacle case.

Habitat: The Texas lilliput is found in streams, rivers, creeks, bayous, and sloughs. The mussel prefers a slow to medium current and a mud or sand substrate. The mussel is more common in shallow water than deep, and is usually found near the banks of rapidly flowing rivers or streams.

Status: No live Texas lilliputs were found on Hillside NWR, but two shells were found on the banks of Black Creek at site 15H. The mussel is probably present on the refuge, but is not common.

Tritogonia verrucosa
Pistolgrip



The female pistolgrip can be distinguished from the male by the elongated posterior end. The males tend to have a less elongated posterior end. This is a *sexually dimorphic* species. In this photograph, the mussels to the far left and middle are females.

Host Fish include the yellow and brown bullheads and flathead catfish.

Characteristics: This mussel has a thick, elongated, bumpy shell. The pustules on the posterior end of the mussel are larger and more pronounced, and the ventral edge has a sharp concave curve. The periostracum is brown, or black, and the nacre is bright white and often iridescent. The hinge of the pistolgrip consists of large teeth, and the beak extends just over the hinge. The mussel can reach eight inches in length.

The pistolgrip is sometimes confused with the bankclimber (*Plectomerus dombeyanus*), but can be differentiated by the deep sulcus of the pistolgrip, and the more rounded dorsal end. This mussel's bright white nacre contrasts with the dark purple nacre of the bankclimber. The pistolgrip also lacks the high posterior ridge of the bankclimber.

Habitat: The pistolgrip prefers moving water and is found in creeks, streams, and rivers with fast to medium currents. Pistolgrips prefer mud, sand, or gravel.

Status: The pistolgrip was the most abundant mussel found on Hillside NWR. The bed in Black Creek at site 15H was made up primarily of pistolgrips.

Truncilla truncata
Deertoe



Host Fish include the freshwater drum and the sauger.

Characteristics: The deertoe has a slightly triangular shape, with a sharp, distinct ridge on the posterior side. The shell is thick, and the beak extends past the hinge line. The periostracum is dark yellow, green, dark brown, or black, often with rays and zigzag markings. In juveniles, the periostracum can be a pinkish color, and the nacre is often dark pink. The nacre is typically white, sometimes light pink, in mature adults. The teeth of the deertoe are well developed. The mussel can reach up to 2 ½ inches in length.

Habitat: The deertoe is usually found in rivers and streams with a strong to medium current and a sand, gravel, or mud bottom

Status: Although no live mussels were found on Hillside NWR, several shells were found at site 15H. Some of the shells were fresh, suggesting that the mussels are still present, but are not common on the refuge.

Unio merus tetralasmus
Pondhorn



The **Host Fish** is the golden shiner.

Characteristics: The shell of the pondhorn is fairly thin, elongate, and light to dark brown. The periostracum is smooth, and the nacre is white or light pink. The teeth are thin and small. The beak is not high and usually stops even with the hinge line. This mussel can reach five inches in length.

Habitat: The pondhorn prefers slow moving or still water, and is typically found in ponds, lakes, oxbows, and small creeks. The mussel prefers a mud or a sand substrate.

Status: The mussel was not found on Hillside NWR but is likely to occur in some of the sloughs, swamps, lakes, and perennial ditches located on the refuge.

Utterbackia imbecillis
Paper Pondshell



Host Fish include the mosquitofish, pumpkinseed, warmouth, bluegill, and creek chub along with several species of bass, killfish, shiners, darters, sunfish, perch, and crappie. The paper pondshell has even been known to use the bullfrog as a host.

Characteristics: The paper pondshell has a very thin shell, which is yellow to yellow-green in color. The nacre is white to bluish white. The beak does not extend over the hinge, and the shell is oblong. This shell has no teeth. Length is about four inches for adults.

Habitat: The paper pondshell is typically found in still or very slow moving water. The mussel occurs in ponds, lakes, and some streams, rivers, and creeks. Mud is the preferred substrate of the paper pondshell.

Status: The mussel was not found on Hillside NWR during this survey but is likely to occur in some of the sloughs, swamps, lakes, and bayous located on the refuge.

The paper pondshell is a *hermaphroditic* species, or has both male and female sex organs.

Corbicula fluminea
Asian Clam



Asian clams are an introduced species. They are known to form dense single species beds containing thousands of mussels per square meter.

The glochidia of the Asian clam go through a planktonic stage rather than a parasitic phase. Therefore, these mussels do not require a host fish. Also, the Asian clam is a hermaphrodite, and is capable of self fertilization.

Characteristics: The Asian clam is small with a slightly rounded or triangular shape. The beak is high and located in the center of the shell. The periostracum is yellow to brown or black. The teeth are small, and the nacre is white, purple, or pink. The mussel only reaches about 1 ½ inches.

Habitat: The Asian clam resides in rivers, streams, creeks, lakes, ponds, sloughs, and oxbows and can live in silt, sand, mud, or gravel.

Status: Several live Asian clams were found in Black Creek at site 15H, but the clam is not common on Hillside NWR.

Hillside NWR Survey Sites
Friday, July 12, 2002

Site 15H: Black creek

Under bridge at Thorton Rd.; mixture of sand, gravel, soft mud, and firm mud on bottom; alligator weed on banks; steep banks, strong current; water one to six feet deep; dense mussel bed; dominant species is the pistol grip; mussel bed extends downstream from bridge; after 50 yards, the water became too deep, and the current too strong to survey further; at 50 yards, the bed showed no signs of slacking off, and extends further downstream

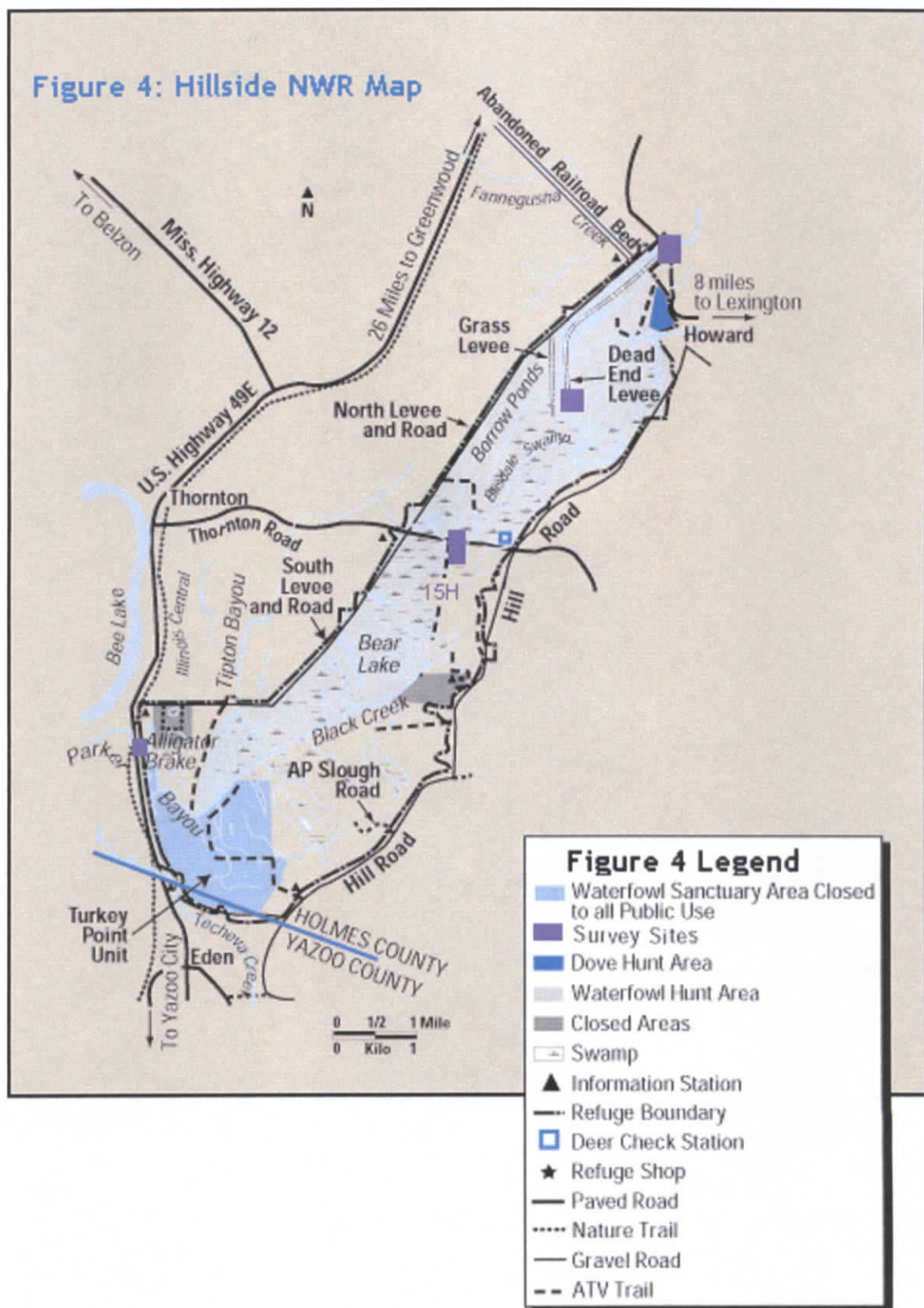
Parker Bayou was surveyed from the boat ramp off Highway 49 East. The water was deep and muddy, and no shells were found.

A number of ditches, oxbows, and other areas along Southside Rd. were visually searched for mussel shells, but none were found. Some of these sites are marked on the map in Figure 4 but are not assigned site numbers.

Mussels Occurring on Hillside National Wildlife Refuge

<u>Common Name</u>	<u>Scientific Name</u>	<u>Sites Found</u>
Threeridge	<i>A. plicata</i>	15H
Flat Floater	<i>A. suborbiculata</i>	
Yellow Sandshell	<i>L. teres</i>	15H
Fragile Papershell	<i>L. fragilis</i>	15H
Pondmussel	<i>L. subrostrata</i>	
Washboard	<i>M. nervosa</i>	15H
Threehorn Wartyback	<i>O. reflexa</i>	15H
Bankclimber	<i>P. dombeyanus</i>	15H
Bleufer	<i>P. purpuratus</i>	15H
Giant Floater	<i>P. grandis</i>	15H
Wartyback	<i>Q. nodulata</i>	15H
Pimpleback	<i>Q. pustulosa</i>	15H
Mapleleaf	<i>Q. quadrula</i>	15H
Texas Lilliput	<i>T. texasiensis</i>	15H
Pistolgrip	<i>T. verrucosa</i>	15H
Deertoe	<i>T. truncata</i>	15H
Pondhorn	<i>U. tetralasmus</i>	
Paper Pondshell	<i>U. imbecillis</i>	
Asian Clam	<i>C. fluminea</i>	15H

Figure 4: Hillside NWR Map



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http://outdoorplace.org/shells/local_shells.html

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For host fish information, go to:

<http://ellipse.inhs.uiuc.edu/fmcs/>